# NASA Facts

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**Marshall Space Flight Center**
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# NASA's Propulsion Research Laboratory
## at Marshall Space Flight Center

A new, world-class laboratory for research into future space transportation technologies is soon to be under construction at NASA's Marshall Space Flight Center in Huntsville, Ala.

The state-of-the-art Propulsion Research Laboratory will centralize cutting-edge research that could one day improve access to orbit, open the space frontier for ambitious exploration, and strengthen commercial development and human exploration of space.

The laboratory and its principal occupant, the Marshall Center's Propulsion Research Center, will serve as a leading national resource for advanced space propulsion research. Its purpose is to conduct research that will lead to the creation and development of innovative propulsion technologies for space exploration. The facility will be the epicenter of the effort to move the U.S. space program beyond the confines of conventional chemical propulsion into an era of greatly improved access to space and rapid transit throughout the solar system.

The Propulsion Research Laboratory will be designed to accommodate researchers from across the United States. Scientists and engineers from NASA, the Department of Defense, the Department of Energy, universities and industry will pool their skills and expertise to perform landmark proof-of-principle demonstrations in a state-of-the-art and safely isolated—but accessible—location within the Marshall Center.

Unlike other propulsion facilities designed to support a single or limited number of technologies, this new NASA lab will be multifunctional, promoting different research efforts and allowing them to share expensive equipment. It will provide invaluable educational opportunities to students and young researchers and will house a wellspring of innovation to benefit not only NASA but ultimately the commercial sector as well.

The facility—with 66,000 square feet (6,133 square meters) of useable laboratory space—will feature a high degree of experimental capability. Its flexibility will allow it to address a broad range of propulsion technologies and concepts, such as plasma, electromagnetic, thermodynamic and propellantless propulsion. An important area of emphasis will be development and utilization of advanced energy sources, including highly energetic chemical reactions, solar energy, and processes based on fission, fusion and antimatter.

The Propulsion Research Laboratory is vital for developing the advanced propulsion technologies needed to open up the space frontier, and will set the stage for research that could revolutionize space transportation for a broad range of applications.

## Design and construction

The architectural engineering design study for the research laboratory was completed in December 2000. The electrical substation contract is expected to be awarded in April 2002.

The detailed design phase of the building—based on data drawn from previous engineering studies and extensive analysis of researchers' needs—is expected to be completed in June 2002, with the construction contract awarded in September 2002.

Construction is slated to be completed in April 2004, and the facility is expected to be operational by June 2004. Builders will provide options for additional design interfaces and utilities, enabling future expansion of key sections of the building.

An environmental assessment was conducted to ensure that activities performed in the facility are in full compliance with environmental regulations. Public hearings on the environmental assessment were held in early 2002.

## Research labs

Technologies that will be investigated in the Propulsion Research Laboratory are on the cutting edge of modern propulsion science and engineering.

One of the facility's labs will be dedicated to **antimatter propulsion**. The collision and mutual annihilation of matter and antimatter is the most energetic reaction known in physics. The Marshall Center and its industry and education partners are engaged in unique research to develop technologies for storage and use of antimatter for space propulsion. Minute amounts of antimatter will be used in the lab for this research.

Another lab will have capabilities for **beamed energy propulsion** research. Spacecraft powered by microwaves or lasers could deliver better performance than conventional chemical-fueled systems because most of the heavy energy source would remain on the ground or in orbit, separate from the vehicle. Beamed energy also could help change the orbital trajectory of space debris, preventing unnecessary damage to operating spacecraft.

The **advanced chemical synthesis** lab will focus on dramatic improvements in chemical propellants. Activities will include advanced research and evaluation of new, energetic propellants and fuels. Researchers also will investigate chemical combustion physics and technologies, and seek improvements in current operating chemical systems.

In the **simulated fission propulsion** lab, researchers will examine the potential for using fission heat to energize propellant for spacecraft to journey to deep space. Heat from fission reactions will be simulated using resistor heating techniques and converted to electricity to power an electric thruster. Resistors also may be used to heat a gas propellant that subsequently expands through a nozzle, creating thrust.

One technology area that applies to a broad range of electromagnetic concepts involves high power plasmas, or electrically charged gases. Activities in the **plasma propulsion** labs will focus on investigation of efficient plasma energization, containment and directed thrust. Fusion energy also may be obtained from high-powered plasmas, greatly improving propulsion performance for ambitious exploration of our solar system. Other important, related research areas include propulsion controls, pulsed fields, plasma interactions and high-performance switching technology.

The **solar laboratory** will be capable of exposing large, inflatable concentrators to direct sunlight—78,000 watts of power—for propulsion experiments. In Earth orbit, solar energy is available at an intensity of approximately 130 watts per square foot (1,400 watts per square meter). By comparison, solar energy on the planet's surface—routinely limited by clear weather and nightfall—is only available at 93 watts per square foot (1,000 watts per square meter), making solar energy collected in space a cheaper and more beneficial energy source for long-duration applications.

Other labs are planned to support additional research. **Advanced experimental diagnostics** also will be a subject of study, as researchers work to develop such innovations as advanced laser-based measurement and high-speed cameras capable of taking 100 million frames per second.

## Flexible facility

A unique feature of the Propulsion Research Laboratory will be its flexibility. If a technology doesn't prove to be as advantageous as expected, the lab can easily be converted to investigate a different technology. It will be possible to simply and safely modify mechanical and electrical power hardware without interrupting research in other areas.

The architecture of the Propulsion Research Laboratory will reflect the high-tech, advanced propulsion research housed within it. It will be a one-of-a-kind, world-class facility with appearance befitting its 21st century purpose. The project architecture-engineering firm is Jacobs Facilities, Inc., of Orlando, Fla.

All laboratory space, engineering resources and technical support will be on one floor of the complex. Plans include a centralized workshop, diagnostics lab, electronics shop, visitors gallery and research lab spaces of various sizes. Broad corridors, about 12 feet (3.65 meters) wide, will permit easy movement of large experiment hardware and portable equipment from room to room.

## More about NASA's Marshall Center

NASA is the nation's premier agency for development of Space Transportation systems, including future-generation reusable launch vehicles. Such systems require revolutionary advances in critical aerospace technologies, from thermal, magnetic, chemical and propellantless propulsion systems to new energy sources such as space solar power or antimatter propulsion. These and other advances are now being studied, developed and tested at NASA field centers and partner institutions all over the nation.

NASA and its partners also seek innovative materials and processes for developing safer, stronger and more durable engines, vehicles, structures and components to handle the immense power of these futuristic propulsion systems.

The Marshall Center is a key leader for all these efforts, aimed at enabling dramatic improvements in the safety, cost and reliability of future space transportation systems. For more information about NASA Space Transportation Systems, visit:

**http://www.spacetransportation.com**